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PRINCIPLES OF OME Exam

9TH July 2020

① Combustion is a release of energy without great change in pressure. Heat propagates through a material resulting in flame and hot gas permeation.

Deflagration is a much more violent chemical reaction and a rapid burn releasing hot gas and flame.

Detonation is a decomposition reaction where a supersonic shockwave passes through a material converting it to gas and pressure.

② Where an energetic substance has sufficient power and if the heat of combustion is contained i.e. confined in a pipe bomb, the burning rate of the substance and the pressure wave increase in intensity. If the propagation rate reaches the speed of sound in a material, it becomes a detonation. This is deflagration to detonation.

③

- Charge Size within the round, if increased it would increase blast.
- Fragmentation patterns - etched casings can assist in producing fragmentation.
- Body material will affect fragmentation pattern, size etc

(4) Primary explosives substances are very sensitive to friction, heat, impact and detonate when sufficient energy or stimulus is applied. Example - Lead Azide.

Secondary explosives require more energy inputted, usually by detonation, are safer to handle than primary explosives as they are less sensitive. Example - RDX

A booster is the intermediate between the initiator^{or}/detonator and the main charge. It must be able to accept the energy from the detonator and output enough energy to transfer to the main charge. Eg. fuze gaine.

(5) Propellant grains can be designed to burn differently, and at different rates.

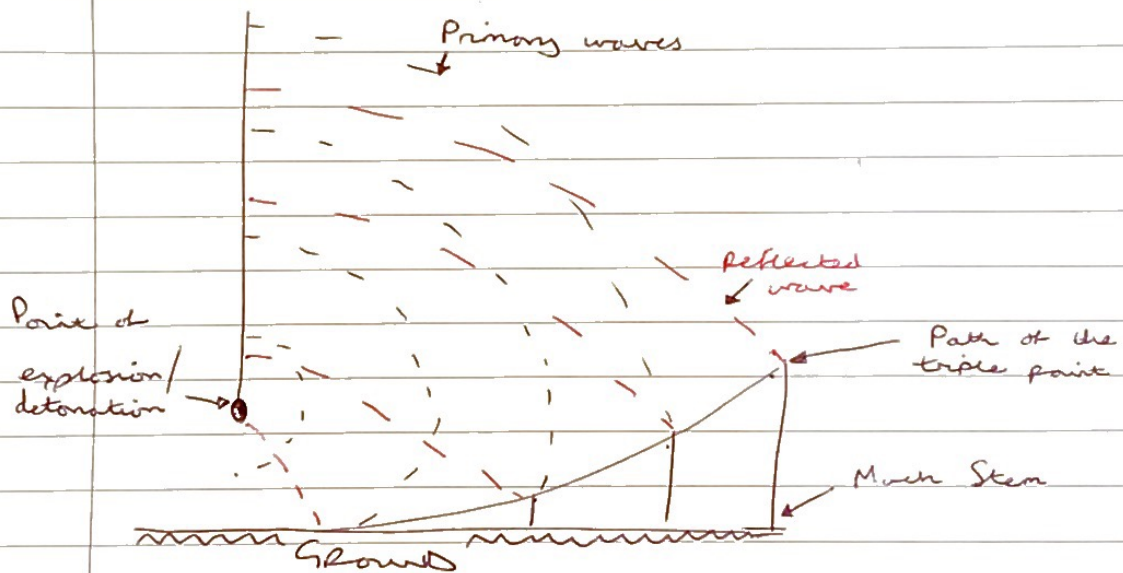
A propellant grain with several holes will have a larger surface area and burn more quickly than a standard grain.

As the propellant grain burns on its surface the surface area being burnt increases, which in turn helps to increase the burn rate.

- ⑥ If the particle size of the aluminium was decreased i.e. into a fine powder then it would increase its surface area and mix more evenly with the potassium perchlorate. The smaller the particle size the greater the surface to volume ratio, so it heats up more quickly resulting in a more energetic burn.

Section B

①

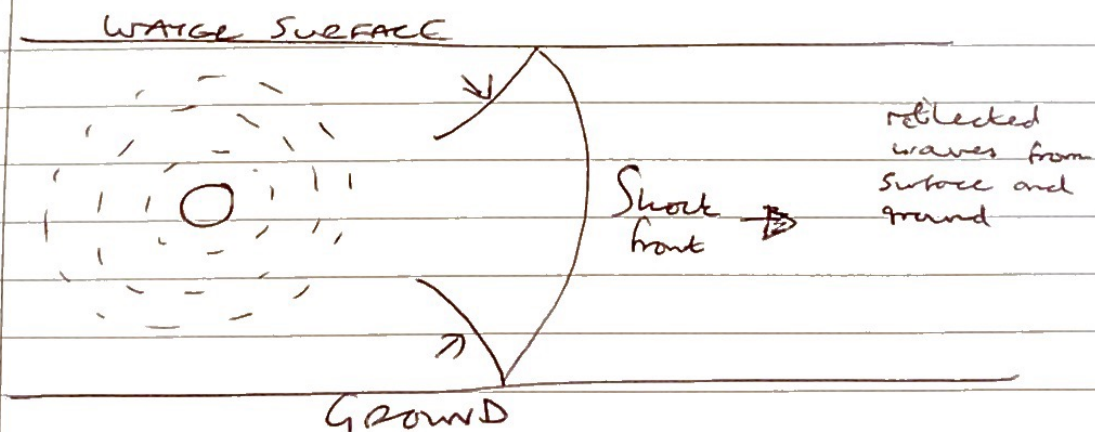


The primary waves come directly from the explosion site. The reflected wave is the wave that returns from the ground.

A warhead designed to detonate in air must consider the following to ~~maximise~~ ^{maximise} its effectiveness :-

- Increased fragmentation - More high velocity fragments increases ~~a~~ ^{the} chance of hitting target
- Optimum sized fragmentation - a polished liner can localise shock and create effective fragmentation
- Increased charge size - increase blast effects

Underwater Blast warheads - when a detonation occurs under water the gaseous products are trapped as a bubble. The bubble then expands and over expands, then contracts and over contracts, this oscillation continues for several cycles. The bubbles are drawn to nearby surface targets



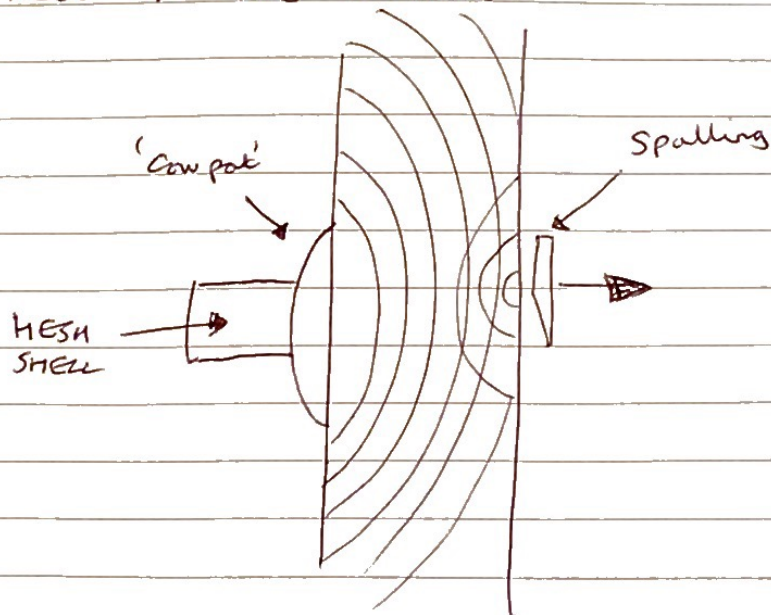
The target receives ~~both~~ ^{both} the primary shock and reflective shock.

Air blast fragmentation warheads are designed to be effective at targeting aircraft as they have little armour. The fragmentation is effective. They are Omni-directional and are relatively cheap and of simple construction. The disadvantages are that some external blast is wasted due to its omni directional feature. It also has increased collateral damage and the warhead can be sensitive to altitude.

Question 2

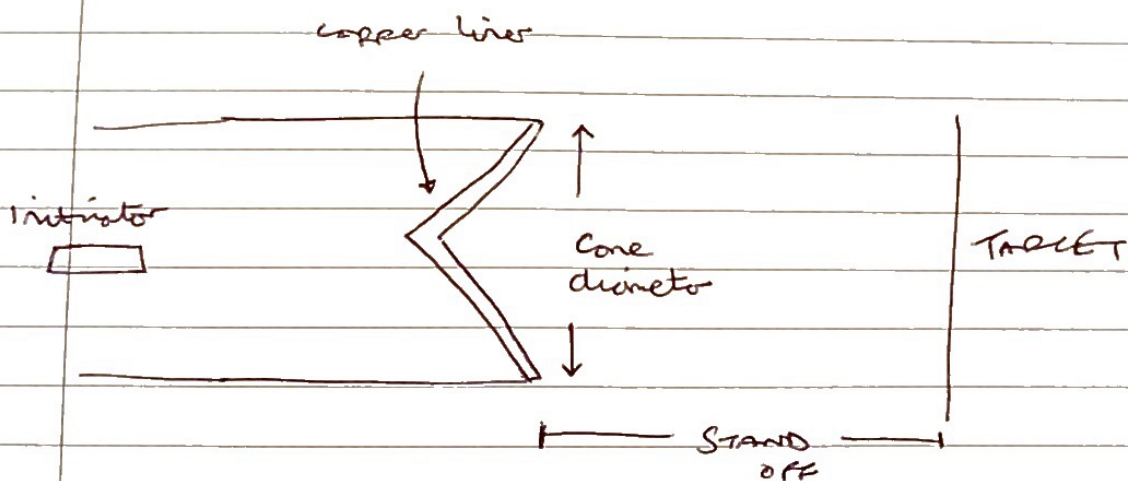
High Explosive Squash Head

On impact with the target the shell squashes into a 'cow pat' shape. The charge is detonated from the rear when the cow pat has formed. The supersonic shock wave travels from the explosive charge into the target armour. This creates spalling and a scud breaks from the rear of the armour.



The explosive filling must be able to withstand the firing forces acting on the shell and be safe to handle and transport during normal use. The charge must be of sufficient size to transmit the required energy and transfer a shockwave into the armour. The inert bitumen placed in the nose of the shell is designed to absorb some of the impact and delay the detonation until enough material has covered the target armour. For this MESH effect to work the shell must hit the target. If it fails to hit directly then the effects are very reduced. The target still experiences blast and fragments but they ~~are~~ ^{are} designed to withstand these.

Shaped Charge



A shaped charge is initiated at the rear. As the shockwave travels through the charge it turns the copper liner into an extremely fast molten jet ($> 1000 \text{ m/s}$) which erodes the target and 'pushes' through to penetrate armour.

The explosive fill must be evenly filled in the warhead so that the detonation is consistent and initiated ~~near~~ from the rear. The cone diameter is determined by the stand off - or vice versa. A larger cone diameter would require a larger stand off distance.

This effect requires initiation at a stand off distance. If the initiation occurs too early, the molten jet begins to break up and reduces penetration capability. If the detonation occurs too late i.e. closer to the target then there is not ~~enough~~ enough time for the jet to form, which reduces its effectiveness.

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